Sub a1

~~METHOD FOR THE COMPRESSED CORDLESS COMMUNICATION BETWEEN A BASE STATION AND A PLURALITY OF MOBILE PARTS~~

The invention is directed to a method for the compressed cordless communication between a base station and a plurality K of mobile parts via a plurality of ~~K*<K~~ with K* which is < K, physical radio channels and is also directed to a base station and to a mobile part for a compressed cordless communication.

Description of the Related Art

Due to the great increase in cordless communication via radio, the radio frequency spectrum ~~represents~~ is a tight, non-expandable resource and should be utilized as efficiently as possible. In current analog and digital mobile radiotelephone systems, a physical radio channel between the base station and a mobile part is permanently allocated for the duration of a call within a communication cell. Three methods are fundamentally known for dividing the transmission bandwidth that is ~~thereby available onto~~ available to the individual subscribers or, respectively, mobile parts. In TDMA (**T**ime **D**ivision **M**ultiple **A**ccess), the data of different subscribers are transmitted in time-division multiplex in different time slots. In FDMA (**F**requency **D**ivision **M**ultiple **A**ccess) methods, subscriber are divided onto different frequency bands; and, in CDMA (**C**ode **D**ivision **M**ultiple **A**ccess) methods, the data of different subscribers are encoded with different codes. Combinations of two of these methods are often employed in practice. For example, the GSM mobile telephone standard ~~(Global System for Mobile Communications)~~ employs a combination of TDMA and FDMA. A combination of TDMA and CDMA is under discussion for future mobile communication standards.

A certain percentage of a telephone call is composed of pauses in speech. Great fluctuations of the transmission data rate also occur in data communication. The method of statistical multiplexing is known in the asynchronous transfer mode (ATM) in fixed-network communication, ~~whereby~~ in which the transmission data of a great number of logical communication connections are divided into data blocks and are transmitted by blocks in time-division multiplex statistically distributed onto a lower

number of physical communication channels. ~~As a result thereof,~~ Ins a3 transmission capacity and memory capacity as well (for example, of a call answering unit) can be ~~optimally utilized~~.

In TDMA radio transmission systems, the use of statistical multiplexing has ~~hitherto run afoul thereof that~~ previously been problematic because, in contrast to fixed-network connections, it is not a matter of a point-to-point connection ~~wherein~~ in which all information about the data to be transmitted are present at both end points. The link from the base station to the mobile parts is a point-to-multipoint connection (see ~~the schematic illustration in~~ Figure 1). Conversely, the transmission path from the mobile parts to the base station is a multipoint-to-point connection. Given this configuration, only the base station has the information needed for the setup of a statistically multiplexed connection.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to ~~propose~~ provide a method for the cordless communication between a base station and a plurality of mobile parts ~~wherein~~ in which the available transmission bandwidth is utilized as efficiently as possible.

Subs a4

~~This object is achieved by the method for compressed cordless communication defined in claim 1 as well as by the base station defined in claim 15 and the mobile part defined in claim 17. Advantageous developments of the invention are described in the subclaims.~~

~~The inventive method for compressed cordless communication between a base station and a plurality K of mobile parts via K*<K physical radio channels comprises the following method steps:~~

-- ~~acquisition of pause sections in the respective transmission data in the base station and the mobile parts;~~

-- ~~storing the transmission data in a transmission data memory (3, 15) in the base station and in the mobile parts;~~

-- ~~storing the appertaining transmission data and transmission pause time reference information in a transmission time reference memory (6, 17) in the base station and in the mobile parts;~~

-- communicating the time reference information from the mobile parts to the base station;

-- determining transmission time intervals of the base station and of the mobile parts with a control means (5) implemented in the base station;

-- transmitting the transmission time intervals from the base station to the respective mobile parts allocated to the individual base stations.

In the inventive method, the compression or concentrator function for both transmission directions is controlled proceeding from the base station. An additional exchange of information between the base station and the mobile parts is required for this purpose. Each mobile part informs the base station of the time reference information of the respective transmission data of the mobile part, whereas the base station that controls the time execution of the communication in both directions communicates the respective transmission time intervals to the mobile parts. The base station thus has the information about transmission times and transmission pauses of all K mobile parts and can use the transmission pauses to transmit the data of other respective ~~respectively other~~ connections. It is thus possible to maintain a plurality K of logical connections via a smaller plurality K* of physical radio channels. The degree of compression is dependent on the average data-to-pause ratio ~~ration.~~

The time reference information from the mobile part to the base station and, conversely, the information about the transmission time intervals from the base station to the various mobile parts, are preferably transmitted in a control information field together with the transmission data. The "overhead" that ~~thereby~~ arises from this is slight compared to the saving of transmission bandwidth due to the compression.

Preferably, a combined TDMA/CDMA method can be applied as a radio transmission method between a base station and mobile part. The invention, however, is not limited to such a method but can also be utilized in other digital radio transmission methods.

Independently of the data transmission, the base station preferably communicates a control signal for updating the reception data memory of the mobile

part to all mobile parts at regular intervals. For example, this can ensue every four TDMA time frames.

The transmission data are stored in the transmission data memory of the base or, ~~respectively~~, of the mobile parts, preferably in blocks corresponding to a fixed transmission duration~~, whereby~~ in which the duration advantageously corresponds to the length of a TDMA frame or a multiple thereof. The size of the transmission data and reception data memory is preferably a whole multiple of this block size and is selected corresponding to the maximally allowed delay time, for example 48 ms for voice communication.

In order to assure a good-quality voice transmission, the data output from the base station to a connected communication network or from the mobile part to a user is controlled such that the transmission running time arising due to the intermediate data storage at the transmission and reception side is always constant for all channels.

The transmission pauses are stored in the time reference memories of the base station and of the mobile parts, preferably in the form of whole multiples of a transmission data block length. Upon output of the data from a mobile part to a user or, respectively, the base station to a connected communication network, the pauses are reinserted into the data stream in proper time dependent on the time reference information stored in the reception time reference memory, so that the original data/pause sequence is restored.

According to a preferred exemplary embodiment of the invention, the controller ~~control means~~ of the base station assures that each mobile part can transmit at least once in a time interval that corresponds to its transmission data memory length. It is thus assured that a data outage does not occur.

According to another preferred exemplary embodiment, the base station informs the respective mobile parts -- dependent on the data stored in the transmission data memories of the base station and of the mobile parts -- whether the mobile part transmits and/or receives for a specific time duration or executes none of these

functions. When a transmission part and/or reception part of the mobile part can be turned off for a specific plurality of time slots, then power can be saved at the mobile part.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is explained below on the basis of preferred exemplary embodiments with reference to the accompanying drawings, ~~wherein~~

a

Figure 1 is a schematic illustration of the cordless communication between a base station and a plurality of mobile parts;

Figure 2 is a function block diagram of an inventive base station and an inventive mobile part;

~~Figure 3~~ ~~an illustration~~ of the functioning or a preferred exemplary embodiment of the inventive method.

Ins a5

Ins a6

An exemplary embodiment of an inventive base station and of an inventive mobile part are explained below with reference to Figure 2. ~~Let~~ it be pointed out that mobile part does not necessarily mean a mobile telephone or car telephone. Mobile part is to understood as meaning any communication terminal device that forms a multipoint-to-point connection with the base station.

subs a 7

The base station shown at the left in Figure 2 is explained first. Transmission data such as~~, for example,~~ voice data or data for the data communication proceed to the base station from a data input E that, for example, is connected to a telephone fixed network or a mobile radiotelephone network of a different operator or the like. A data/pause acquisition mechanism ~~means~~ 1 acquires data pauses in the input data. The input data are subsequently intermediately stored in the input data memory 3 in blocks that Correspond ~~corresponds [sic]~~ to a fixed transmission time, for ~~example~~, the frame length of a TDMA frame. The information about the chronological succession of data and pauses is stored in a transmission time reference memory 6 in units of block lengths, being stored Within by a Controller ~~therein by a control means~~ 5. One respective transmission data memory 3 and one respective transmission time reference memory 6 is present per K data inputs. On the basis of the current content of the transmission time reference memory 6, the control logic determines the sequence with which the K input channels are conducted

to the transmitter ~~transmission means~~ 10 with the assistance of the modulator/concentrator* and transmitted via the radio link. The base station can simultaneously set up a maximum of K* physical radio channels. Before sending the data, the controller ~~control means~~ 5 attaches additional information to the data packet as to when the respectively receiving mobile part is allowed to transmit next.

The data transmitted via the radio link in K* physical channels are received by a receiver ~~reception means~~ 12 of the mobile part and intermediately stored in a reception data memory 14. The time reference information communicated from the base station and belonging to the received data is stored in the reception time reference memory 16. Dependent on the time reference information intermediately stored in the memory 14, the controller ~~control means~~ 18 of the mobile part recombines the reception data intermediately stored in the memory 14 into the original transmission data with the original data/pause ratio and outputs these at the output A1, a demodulator and a loudspeaker for audio output, for example, being connected to the latter.

The voice data produced, for example, by a subscriber proceed via the data input E1 of the mobile part to the data/pause acquisition ~~means 20.~~ Ins a8 The data pauses are acquired thereat as in the base station, and the appertaining time reference information are stored in units of data blocks in the transmission time reference memory 17 of the mobile part. The transmission data themselves are stored in the transmission data memory 15 of the mobile part.

The size of a data block to be stored meaningfully derives from the TDMA time frame structure. When, for example, the TDMA frame length is ~~amounts to~~ eight time slots of 0.5 ms each (4 ms total) ~~= 4 ms,~~ then a data block to be stored should not be smaller than 4 ms or a multiple thereof. From, for example, a maximally permitted delay time of 48 ms given voice communication and the block length of 8 ms, the maximum size of the transmission memory and reception memory derives as six blocks each.

Using the transmission time interval information transmitted from the base station together with the transmission data, the controller ~~control means~~ 18 of the mobile part

controls the transmission time intervals of the data stored in the memory 15 with the transmitter ~~transmission means~~ 13. The base station must thereby assure that each mobile part is allowed to transmit at least once in a time interval that corresponds to the transmission data memory size 15. An overflow of the transmission data memory 15 and a connected data ~~loss connected therewith are thus also assured [sic!!] given a user of a mobile part for~~ Ans ag which the data/pause acquisition mechanism ~~means~~ 20 cannot identify any data pauses.

Moreover, the base station must assure that mobile parts that do not comprise any current transmission data in their transmission data memory 15 are also regularly addressed, for example, every four time slots, and the status of their transmission memory 15 is thus updated.

The data sent from the mobile part proceed via the radio link to the receiver ~~reception means~~ 11 of the base station and are subsequently demodulated by a demodulator/expander 9 and expanded onto K channels and intermediately stored in K reception data memories 4. The time reference information transmitted by the mobile part together with the transmission data, i.e., the content of the transmission time reference memory 17 of the mobile part, is communicated to the controller ~~control means~~ 5 by the receiver ~~reception means~~ 11 of the base station. The controller ~~control means~~ 5 of the base station thus "knows" the content of all transmission time reference memories 6 of the base station and of the transmission time reference memories 17 of all mobile parts and thus has information about all required transmission times and transmission pauses of the K logical communication channels. The controller ~~control means~~ 5 can thus optimally utilize the limited resources of the physical radio channels K*. The selection of the ratio of K* to K is determined by the average data-to-pause ratio of the communication system. Given a usual pause part of about 2/3 in the transmission data, a compression ratio of K/K*=2 is realistic.

The reception time reference memory 7 belonging to a mobile part is updated in the base station with the time reference data communicated from the transmission time reference memory 17 of the mobile part. The data stored in the reception data memory 4 can thus be output in turn at the data output A, for example

to a telephone fixed network, with the original data/pause sequence controlled by the controller ~~control means~~ 5.

The transmission method can, for example, employ a combined TDMA/CDMA structure. joint detection ~~Given what is referred to as a joint-detection~~ CDMA, a TDMA structure with, for example, eight time slots per frame can be employed. A plurality of data packets, for example up to eight, can be simultaneously sent within each time slot. The individual data packets are spread and transmitted via the same frequency band with different codes. The receiver in turn separates the individual data packets with the assistance of the spread codes that are known at the receiver. In the practical application, a spread code is allocated to each mobile part. When K=16 mobile telephones with eight different codes are allocated to a base station, then it is possible that all eight mobile parts simultaneously set up, for example, a voice connection. The permitted plurality of codes per transmitted burst, however, only amounts to K*=8. The data can no longer be separated given more codes simultaneously. An operating condition thus occurs in which ~~derives wherein~~ only K*=8 physical duplex radio channels are available to K=16 logical connections. Due to the inventive compression method, this is possible given an average ratio of data to pause of approximately 1:3 in each direction, so that half of the transmission capacity can be saved. Since the ratio of 1:3 is a statistical average, however, the data memories (3, 4, 14, 15) must be large enough ~~so large~~ that fluctuations of the distribution can be compensated. For As described above, the size of the data memory is limited by the maximally permitted delay time that, for example, still allows an undisturbed voice communication.

The following Table describes an example of the function execution of the inventive communication method with a plurality of 16 mobile parts over a plurality of K*=8 physical radio channels.

Table

Base Station		Mobile Parts
Base station has determined which data packets must be sent next.		
1. Mobile part addresses: 1 through 8 bit from 16. Note: It must be assured that mobile parts that have reported no current transmission data are also regularly addressed, at least every 4 time slots, and their transmission memory status is updated.	→	2. All mobile parts receive the data. The 1 through 8 addressed mobile parts register the addressing.
3. Time position of the data in the time reference memory: 1 through 8 times 4 bits, belonging to the mobile part addresses.	→	4. The 1 through 8 addressed mobile parts update the time reference memory (16).
5. 1 through 8 data packets, belonging to the mobile part addresses	→	6. The data are decoded and stored, the data are deposited in the reception data memory (14).
7. Mobile part enable for the next reception time slot, 1 through 8 bits from 16	→	8. All mobile parts receive the data. The 1 through 8 mobile parts that are allowed to send the next time store this enable.
		All mobile parts that have received the send enable send simultaneously.
10. Base station stores the data packet in the appertaining reception data memory (4)	←	9. Data packet
12. Base updates the appertaining time reference (7). The base station calculates the current transmission sequence on the basis of the occupancy of the time reference.	←	11. Current occupancy of the buffer memory and of the time reference for the next 4 time slots. 4 bits per 1 through 8 mobile parts

A further example for illustrating the functioning of the inventive communication method is described below with reference to Figure 3.

Figure 3 shows the exemplary occupancy of transmission data memories and reception data memories of a communication connection on the basis of an example with K=8 logical connections or, respectively, mobile parts via K*=4 physical radio channels, ~~whereby~~ in which the communication direction is immaterial.

Each letter (A-H) corresponds to a data packet of a specific length. Unlabeled fields in a data memory correspond to pause blocks. The data blocks that are not in bold face in the reception data memory (right) in the first or second column were not transmitted at the proper time. The transmission ensues earlier because transmission capacity was present. The packets are in turn classified in proper time later with the information from the time reference memory. At time T=6, one can see that the entire data field that was in the transmission data memory (upper left) in time

step T=1 was transmitted into the reception data memory (lower right) at the proper time.

This example applies fundamentally both in the direction from the base station to the mobile part and vice versa. ~~Given~~ For the transmission from the base station to the mobile part, the entire transmission data memory for all K=8 logical communication connections is situated in the base, ~~whereby~~ in which the eight lines of the illustrated reception data memory are divided onto the eight mobile parts (A-H). In the transmission from the mobile parts to the base station, conversely, the transmission data memory (left) is divided onto the individual mobile parts and the reception data memory is situated in the base.

The invention ~~proposes~~ Provides a communication method for compressed cordless communication between a base station and a plurality K of mobile parts via a plurality Ins a10 of K*<K physical radio channels, whereby the available radio transmission bandwidth is efficiently utilized.

Ins a11